AR226-1653

MONTHLY REPORT P. P. BURKS JULY, 1981

I. OBJECTIVE

Eliminate or control at safe levels FC-143 exposure at Spruance and in trade.

A. Commercialyze interim process to produce impregnated yarns free of detectable FC-143. IVQ'81

For Summary

II. SUMMARY

FC-143, a fluorocarbon surfactant supplied by 3M Company and used in polymerization of Teflon® resin at Parkersburg, was reported by the vendor to have embryotoxic effects in laboratory animals. As potential near term routes to eliminate FC-143 from our products, we are evaluating thermal treatment of impregnated yarns, and dialysis and ion exchange treatment of Teflon® dispersion. Heating of impregnated and treated packages of Teflon® and Kevlar® yarns in a bleaching oven for 3 - 5 hours at 190°C removed all detectable FC-143. However, braided packing of Teflon® failed internal packing tests. Initial tests indicated yarns meet specifications. Causes of failure are being investigated. Packing tests of Kevlar® yarns are in progress. Tests of alternate approaches, on-line heating using hot rolls, and removal of FC-143 by dialysis or ion exchange will be complete in August. Work with Analytical Research will determine if heated FC-143 evaporates or decomposes, and will identify decomposition products.

III. DETAILS

Tests in a plant bleaching oven showed FC-143 was removed from Teflon® yarn packages within 3 hours, and from Kevlar® yarn packages in 3 - 5 hours. Using thermocouples imbedded in yarn packages, we found 2.0 - 2.5 hours were required for core yarn to reach the 190° oven temperature. Apparently, removal of FC-143 from packages, by sublimation or decomposition, requires about 1 - 2 hours at 190°C. This value is roughly 2 - 4x the 0.5 hours indicated by Analytical Research results on small (<1gram) yarn samples. Literature reports and discussions with Polymer Products personnel indicate the probable mechanism is decarboxylation to yield CO_2 and 1- hydroperfluoroheptane. The 50-fold excess of Triton® surfactant in the dispersion is believed to accelerate this reaction by providing a high dielectric medium and a source of hydrogen ions. S. S. Shelburne of Analytical Research is working to confirm this mechanism using gas-phase infrared analysis. The hydroperflouroheptane is believed non-toxic but no specific data have been found.

The on-line heating process will be tested using crystallizer rolls in Nomex® semi-works. This test will define time/temperature conditions needed to remove FC-143. Previous laboratory tests suggested 100% removal is possible at residence times of 5 - 10 seconds and yarn temperatures of 250° - 300°. If successful, the on-line process should provide less thermal discoloration of yarn, and higher productivity than package heating.

Removal of FC-143 from Teflon® dispersion, before the yarn impregnation step, is being evaluated by ion exchange techniques at Spruance, and by ultrafiltration (dialysis) tests at two equipment vendors. Ultrafiltration forces solution (water and FC-143) through a semi-permeable membrane while retaining "Teflon® particles. A "Triton" solution is added continuously to maintain the 60% concentration of "Teflon" particles. Removal of FC-143 may be retarded, in both ion exchange and ultrafiltration, by binding to "Teflon" particles. Results will be available in August.

IV. PROGRAM

	Timing
• Complete packing tests with heated Kevlar® yarns	8/7
• Define reason(s) for failure of Teflon® packing	8B
• Define feasibility of on-line heating of "Teflon" yarn using crystallizer rolls.	
- Semi-works test	8/7
- Product analysis	8B
• Define feasibility of FC-143 removal from dispersion by ion exchange or dialysis	goal 8B
• Define mechanism of thermal elimination of FC-143	(Anal. Res.) 8B
• Complete technical and toxicology testing of alternate surfactant (primary candidate) and decide on scaleup	(PPD) 8B

PPB spk
7/29/81